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(54) A spring device with lost-motion transmission

(57) At least one of the fastening means for connecting a piston-cylinder spring device to respective first and second objects is provided with lost motion means for providing a limited lost motion between the piston or cylinder and the respective object fastened thereto.

This provides a spring device (e.g. a gas spring) which is capable of exerting a spring action on an object within a first section of the path of movement of this object and to omit force exertion from the spring device to said object with a second section of the path of movement of this object.

Fig.2

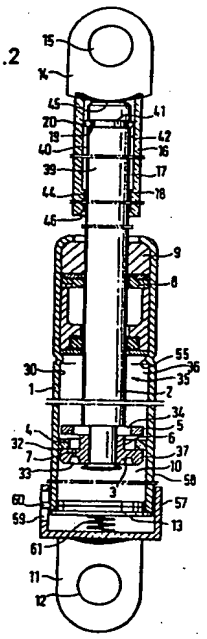

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Fig.1

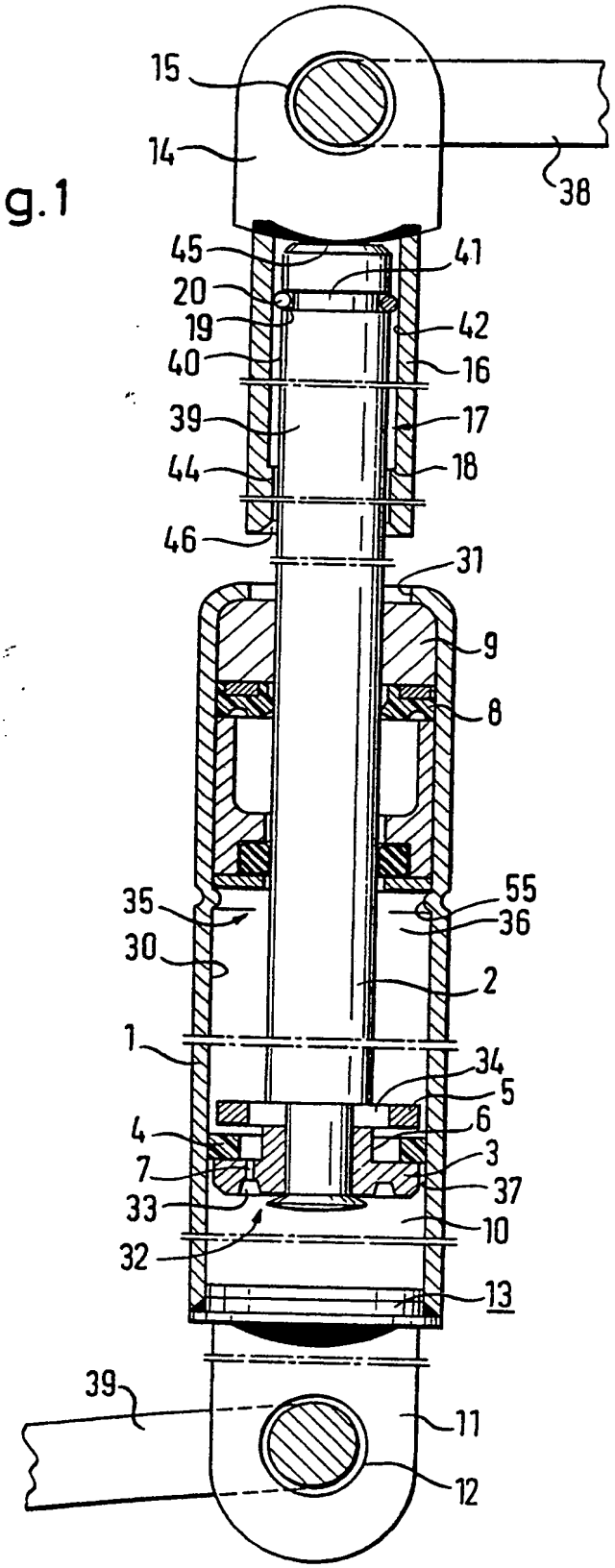

Fig.2

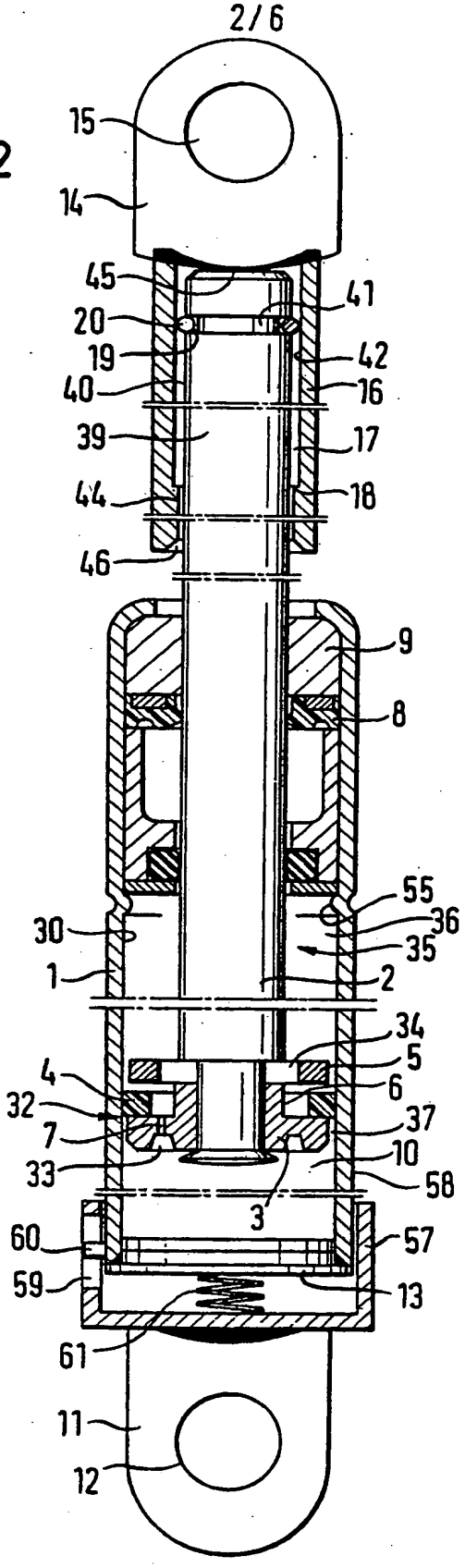
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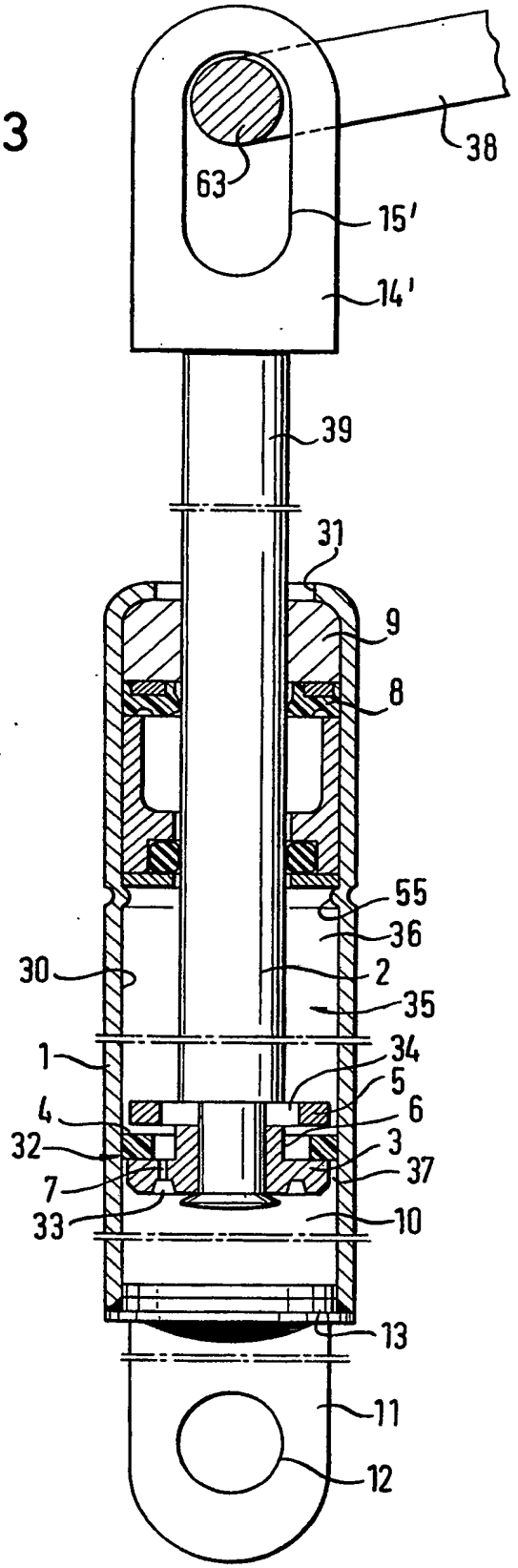
Fig.3



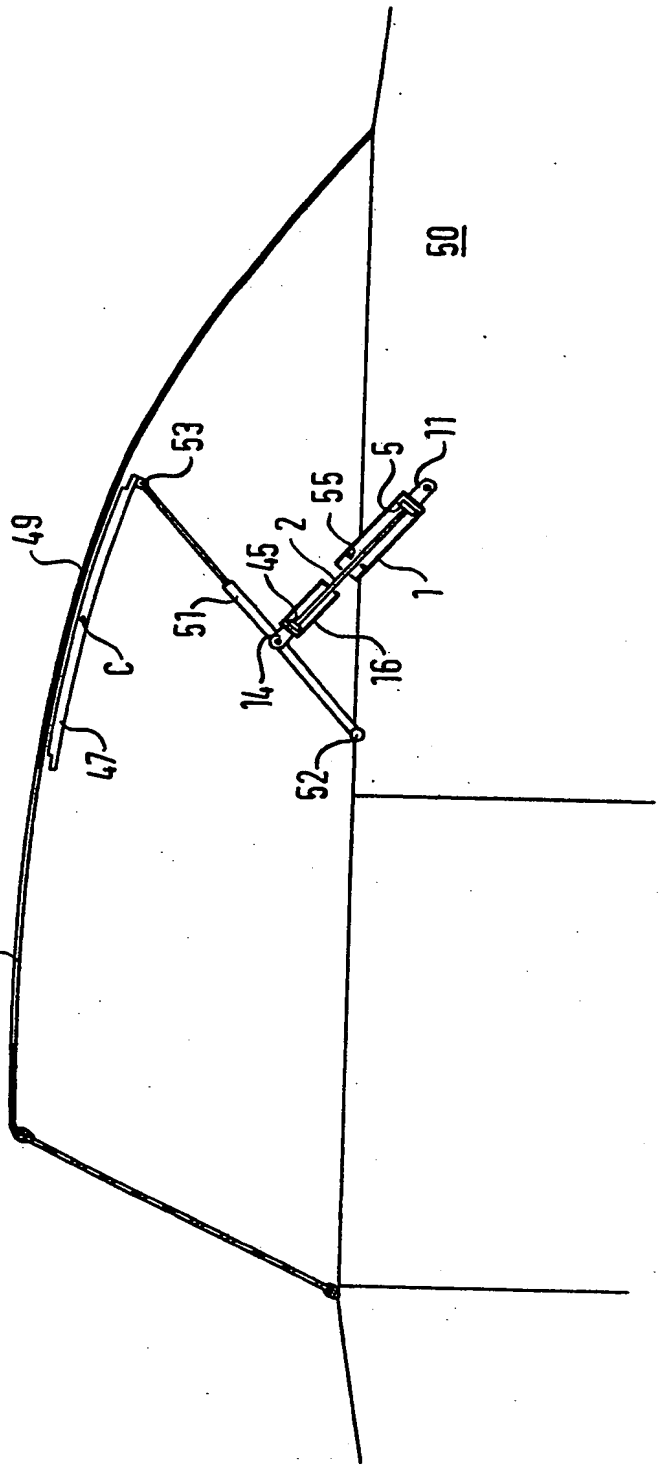


Fig.4

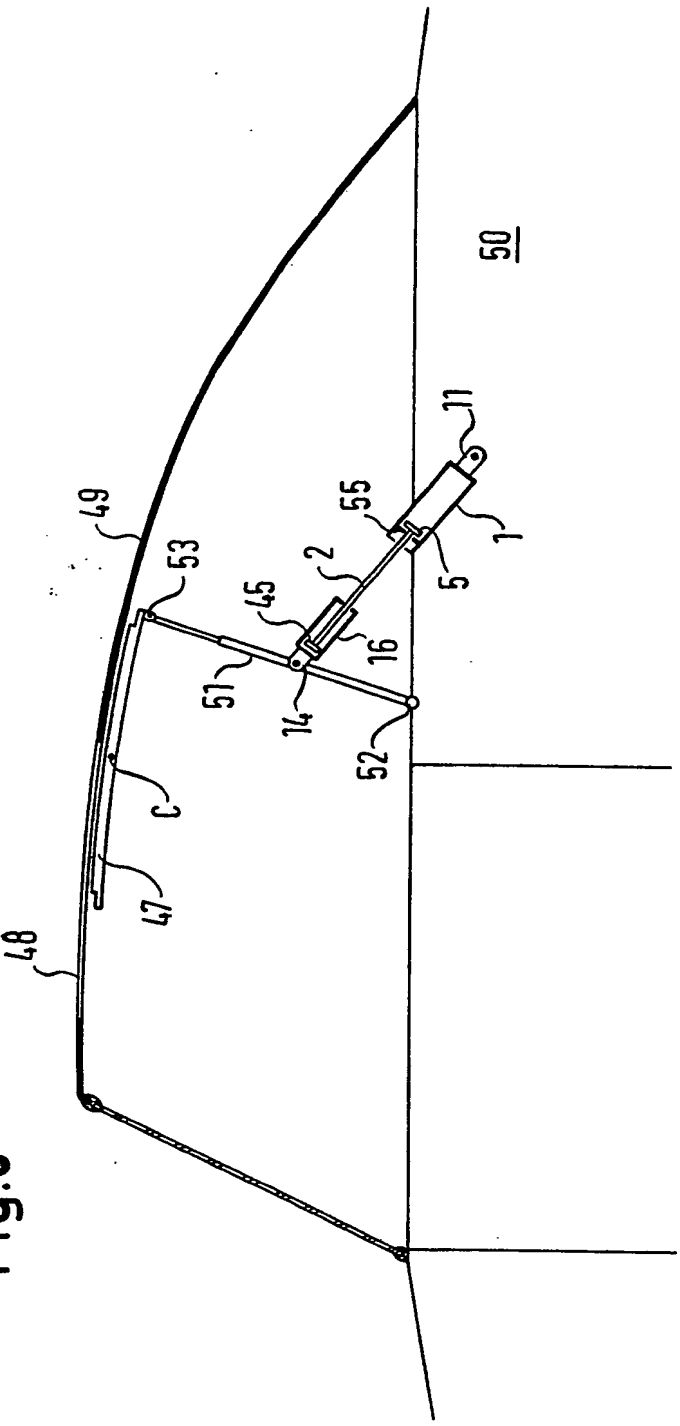


Fig.5

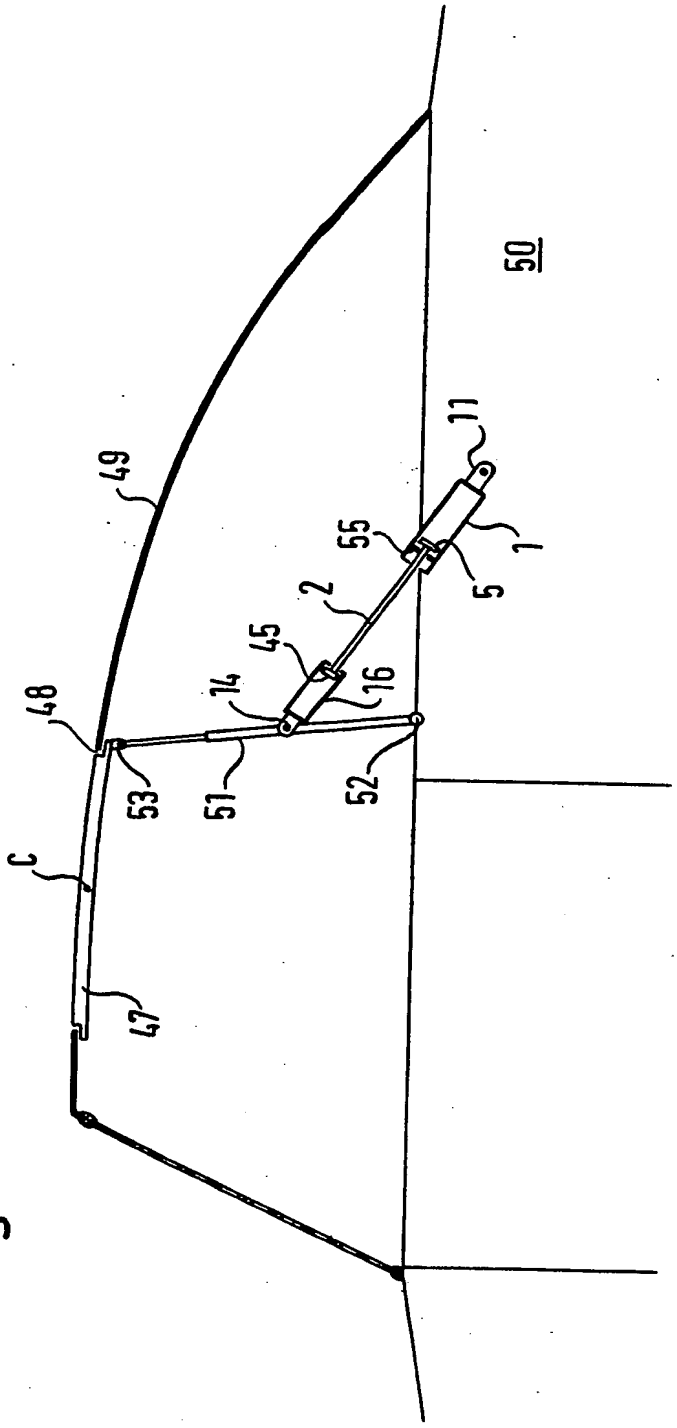


Fig.6

SPECIFICATION

A spring device

This invention relates to a spring device comprising:

(a) a cylinder member having an axis and two ends, a cavity being defined within said cylinder member,

(b) a piston rod member introduced into said cylinder member through an aperture provided in one of said ends, one, the inner end of said cylinder rod member being inside said cavity, a second, the outer end of said piston rod member being outside said cavity, said piston rod member being axially movable with respect to said cylinder member between a first terminal position, in which the axial extent of said piston rod member within said cavity is at a minimum and a second terminal position in which the axial extent of said piston rod member within said cavity is at a maximum,

(c) biasing means within said cavity biasing said piston rod member towards one of its terminal positions,

(d) first fastening means being provided at said piston rod member outside said cavity and second fastening means being provided at the end of said cylinder, which is remote from said apertured end of said cylinder member outside said cavity, said first and second fastening means being adapted for connecting said spring device to respective first and second objects.

Such a spring device is well known in the art e.g. in the form of a pneumatic spring in which the biasing means comprise a pressurised fluid within said cavity.

The known spring devices are e.g. useful in constructions in which an object is movable along a path of movement, the movement of said object being resisted by an external force within a first section of said path and being substantially free of such external force in a second section of said path. In such constructions the spring device may assist the movement of said movable object, so as to overcome or partially overcome the resistance in said first section of the path. There arises however the problem that the spring device acts also on to the object in the second section of the path in which no external or substantially no external force resists to the movement of the object, so that no assistance for the movement is needed from the spring device; in the contrary.

In the second section of the path of movement an action of the spring device would be highly undesirable because when changing the direction of movement it would be necessary in said second section of the movement to overcome the spring action by hand or by operating means used for the movement of the object.

This invention therefore aimes at providing a spring device which is capable of providing a spring action on to an object within a first section of the path of movement of this object and to ommit force exertion from the spring device to said object within a second section of the path of movement of this object.

It is further aim of this invention to avoid specific design features in the construction outside said spring device for ommitting the action of said spring device in said second section of the path of movement.

This aim is achieved according to this invention by the proposal that at least one of said fastening means is provided with lost motion means for providing a limited lost motion between the respective member and the respective object fastened thereto.

This invention can be used e.g. for moving roof elements which in a first section of movement change their center of gravity in a vertical direction, so that movement is resisted by gravity and maintain in a second section of movement their center of gravity on a constant height, so that gravity does not resist movement. Especially useful is this invention in car constructions for assisting the movement of sliding roofs, sunshine roofs and the roofs of convertibles.

It is an advantage of the spring device of this invention that it can be easily incorporated into the respective constructions and that no additional guiding means are necessary for the spring device.

The invention also relates to a construction comprising a spring device.

Further features of this invention are defined in the suclaims.

The invention will be subsequently described with reference to the accompanying drawings in which

Figure 1 shows a first embodiment of the spring device of this invention,

Figure 2 shows a second embodiment,

Figure 3 shows a third embodiment,

Figure 4 shows a spring device of this invention in connection with a sunshine roof of a motor car construction in a first position of said sunshine roof,

Figure 5 shows the construction of Fig. 4 in a second position of the sunshine roof and

Figure 6 shows the construction in a third position of the sunshine roof.

In Fig. 1 a cylinder is designated by 1. The interior face of this cylinder is designated by 30. One end of this cylinder 1 is provided with a bottom wall 13, the other end of the cylinder is provided with an aperture 31. A piston rod or plunger 2 is introduced through the aperture 31 and through a guiding and sealing unit 8, 9 which comprises an annular guiding member 9 and an annular sealing member 8. This piston rod is provided at its inner end with a piston assembly 32. The piston assembly 32 comprises a piston 3 and

a piston ring 4. The piston ring 4 is in sliding contact with the inner cylindrical face 30 and is movable with respect to the piston assembly 32 between the piston 3 and a piston ring supporting member 5. The piston 7 is provided with an axial bore 33, this axial bore 33 comprising a throttle 7. The supporting member 5 is provided with apertures 34. Within the cylinder there is defined a cavity 35. This cavity 35 is separated by the piston assembly 32 into two compartments 10 and 36. The cavity 36 is filled with a gas under superatmospheric pressure acts on the piston rod 2, so as to bias the piston rod 2 outward of said cavity with a force equal to the product of the pressure within cavity 35 and the cross section of the piston rod 2. When the piston rod 2 is moved outward of the cavity 35 by the biasing force exerted by the pressurised gas, the gas flows from compartment 36 into compartment 10 through the bore 33 and is therefore throttled by the throtteling means 7. So the outward movement of the piston rod 2 is damped. When the piston rod 2 is moved inward into the cavity 35 by an external force against the biasing action of the pressurised gas the piston ring 4 is shifted toward the piston ring supporting member, so that a greater flow section is available for the fluid from compartment 10 towards compartment 36 through the gap 37 between the piston 3 and the inner cylindrical face 30 and through the apertures 34. This means that the inward movement of the piston rod is less damped than the outward movement or is not damped at all.

A first fastening member 14 is mounted to the outer end of the piston rod member 2, a second fastening member 11 is fastened to the bottom 13 of cylinder 1. Both fastening members 14 and 11 are provided with cylindrical fastening eyes 15 and 12 respectively for pivotally connecting the spring device to respective objects 38 and 39.

The fastening member 14 is provided with a mounting sleeve 16. This mounting sleeve 16 is slidably mounted on the outer end 39 of the piston rod 2. In theouter face 40 of the piston rod 2 there is provided an annular groove 41. A circlip 20 is inserted into said annular groove 41. This circlip 20 is slidable along a first section 42 of the inner face 17 of the mounting sleeve 16. A second section 44 of said inner face 43 has a smaller inner diameter than the first section 42. A substantially axial directed shoulder face 18 is provided between the first section 42 and the second section 44. This shoulder face 18 abuts the circlip 20, when the mounting sleeve 16 is moved upward with respect to the piston rod 2 as seen in Fig. 1. The upper end face 45 of the piston rod 2 abuts against the fastening member 14, when the mounting sleeve 16 is in its most downward position as seen in Fig. 2.

The mounting sleeve 16 can be easily mounted on the outer end section 39 of the piston rod 2 due to a tapered face 46 provided at the lower end of the mounting sleeve 16 adjacent the second section 44 of the inner face 42. In the initial mounting operation of the mounting sleeve 16 this tapered face compresses the circlip 20 radially inward, so that the circlip can pass over the second section 44 of the inner face 17 until the circlip snaps radially outward behind the axially directed shoulder face 18.

The piston ring supporting element 5 acts as an abutment member limiting the outward movement of the piston rod 2 by interaction with a radially inward projection 55 of the inner cylindrical wall 30.

In Fig. 4 there is shown a motor car construction comprising a sunshine roof element 47. This sunshine roof element is shown in Fig. 4 in its most open position and can be moved toward a closed position in which it is in alignment with an aperture 48 of the roof 49. The guiding means are not shown. It is readily understood however that when the sunshine roof element 47 moves from the position as shown in Fig. 4 to the position as shown in Fig. 5, the center of gravity C of the sunshine roof element is raised. This means, that a considerable force is to be applied to the sunshine roof element for moving it e.g. by hand from the position as shown in Fig. 4 into the position as shown in Fig. 5. For facilitating raising the sunshine roof element from the position as shown in Fig. 4 to the position as shown in Fig. 5 a gas spring as shown in Fig. 1 is provided. The cylinder 1 of this gas spring is pivotally connected by its fastening member 11 to the car construction 50, whereas the fastening member 14 is pivotally connected to a telescopic rod 51, which is at one end pivotally connected to the car construction 50 at 52 and at its other end at 53 pivotally connected to the sunshine roof element 47.

One sees that in the position as shown in Fig. 4 the piston rod 2 is fully introduced into the cylinder 1. When moving the sunshine roof element 47 from the position as shown in Fig. 4 to the position as shown in Fig. 5 this movement is assisted by the spring device which acts on the telescopic rod 51, the piston rod 2 moving outward of the cylinder 1 until the piston ring supporting member 5 abuts the inner projection 55. This abutment position has been reached in Fig. 5. In Fig. 5 the end face 45 of the piston rod 2 is still in engagement with the fastening member 14 as shown in Fig. 1 in more detail. When the sunshine roof element 47 is further to be moved from the position as shown in Fig. 5 to the position as shown in Fig. 6 no substantial further raising of the center of gravity occurs, so that it is not necessary to further assist movement of the sunshine roof element 47 by

the gas spring. A further action of the gas spring on the sunshine roof element would even be undesirable, because it would then be necessary to act by hand against the action of the gas spring, when the sunshine roof element is to be moved backward from the position shown in Fig. 6 to the position as shown in Fig. 5.

Due to the inventive feature of this construction the gas spring has no further action on the sunshine roof element 47 during the movement from Fig. 5 to Fig. 6, because the piston rod 2 can not further move outward from the cylinder 1 due to the abutment action of the piston ring supporting member 5 and the projection 55. This means that during the movement from Fig. 5 to Fig. 6 the abutment face 45 is losing contact with the fastening member 14 and the mounting sleeve 16 slides along the outer section 39 of the piston rod as better shown in Fig. 1 until the circlip 20 abuts the shoulder face 18. This abutment action occurs only, when the sliding roof element is inits fully closed position as shown in Fig. 6. When the sunshine roof element 47 is moved backwards from the position as shown in Fig. 6 to the position in Fig. 5 the lost motion between the end face 45 and the fastening member 14 is overcome until in the position of Fig. 5 the end face 45 abuts again the fastening member 14; only at this stage the biasing action of the gas spring becomes active again for supporting the downward movement of the sunshine roof element from the position as shown in Fig. 5 to the position as shown in Fig. 4.

The suppression of the spring action of the gas spring within the path of movement of the sunshine roof element between the position of Fig. 6 and Fig. 5 is highly desired also because it facilitates the exact positioning of the roof element in all positions between that of Fig. 6 and that of Fig. 5.

A further embodiment of this invention is shown in Fig. 2. In this embodiment the fastening member 11 is provided with a further mounting sleeve 57, which is slidably mounted on the outer face 58 of the cylinder 1. An elongated slot 59 of said mounting sleeve 57 is slidable along an abutment pin 60 mounted to the cylinder 1 for limiting the lost motion of the mounting sleeve 57 with respect to the cylinder 1. A helical compression spring 61 is provided between the fastening member 11 and the bottom wall 13 of the cylinder, so that the fastening member 11 is urged towards one terminal position of the lost motion in which the abutment pin 60 abuts the upper end of the elongated slot 59. The spring action of the spring 61 is smaller along its total stroke than the biasing action of the pressurised gas on the piston rod 2 along its total stroke.

While in Fig. 2 lost motion means are provided on both the cylinder 1 and the piston rod 2 it is to be understood that one can also avoid the lost motion means between the fastening member 14 and the piston rod 2 if lost motion means are provided between the cylinder 1 and the fastening member 11 as shown in Fig. 2.

The embodiment of Fig. 3 shows a different design of the lost motion means. The fastening member 14′ is fixedly mounted to the outer end 39 of the piston rod 2. In this fastening member 14′ there is provided an elongated slot 15′, which is connected to the object 38 by a pivot pin 63 fixed to said object 38. The pivot pin 63 is deplacable along the length of the elongated slot 15′.

This invention is not exclusively applicable to spring devices in the common sense. It is applicable to spring devices in the most general sense including shock absorbers and the like.

CLAIMS

1. A spring device comprising:

(a) a cylinder member having an axis and two ends, a cavity being defined within said cylinder member,

(b) a piston rod member introduced into said cylinder member through an aperture provided in one of said ends, one, the inner end of said cylinder rod member being inside said cavity, a second, the outer end of said piston rod member being outside said cavity, said piston rod member being axially movable with respect to said cylinder member between a first terminal position in which the axial extent of said piston rod member within said cavity is at a minimum and a second terminal position in which the axial extent of said piston rod member within said cavity is at a maximum,

(c) biasing means within said cavity biasing said piston rod member towards one of its terminal positions,

(d) first fastening means being provided at said piston rod member outside said cavity and second fastening means being provided at the end of said cylinder, which is remote from said apertured end of said cylinder member outside said cavity, said first and second fastening means being adapted for connecting said spring device to respective first and second objects,

wherein at least one of said fastening means is provided with lost motion means for providing a limited lost motion between the respective member and the respecive object fastened thereto.

2. A spring device as claimed in claim 1, wherein that terminal position toward which said piston rod member is biased by said biasing means is defined by abutment means provided on said piston rod member and on said cylinder member.

3. A spring device as claimed in claim 1, wherein said fastening means comprise pivot

means for pivotal connection to the respective objects.

4. A spring device as claimed in claim 1, wherein said biasing means comprise a pressurised fluid within said cavity said piston rod member being introduced into said cavity through a guiding and sealing unit provided at said apertured end.

5. A spring device as claimed in claim 4, wherein said pressurised fluid comprises a body of gas at super-atmospheric pressure.

6. A spring device as claimed in claim 1, wherein said piston rod member is provided with a piston assembly within said cavity.

7. A spring device as claimed in claim 6, wherein said piston assembly is guided by an inner cylindrical face of said cylinder member.

8. A spring device as claimed in claim 5, wherein said piston assembly defines first and second compartments within said cavity, said first and second compartments being connected by a passage interconnecting said first and second compartments across said piston assembly.

9. A spring device as claimed in claim 8, wherein said passage comprises throtteling means for damping the fluid flow through said passage when said piston rod member is axially moved with respect to said cylinder member.

10. A spring device as claimed in claim 9, wherein said throtteling means are resposive to the direction of movement of said piston rod member.

11. A spring device means as claimed in claim 10, wherein said throtteling means are responsive to the direction of movement of said piston rod member in such a way that a higher damping action is achieved when said piston rod member moves under the action of said biasing means as compared with the damping effect, when the piston rod member is moved against this biasing action.

12. A spring device as claimed in claim 1, wherein said lost motion means comprise mounting means on the respective member and the respective fastening means, said mounting means providing the lost motion.

13. A spring device as claimed in claim 12, wherein said mounting means of said fastening means comprise a mounting sleeve having an inner face surrounding an outer face of the respective member and slidably mounted thereon between two terminal positions with respect to the respective member.

14. A spring device as claimed in claim 1, wherein the respective member is provided with an outward directed projection on its outer face, said projection being within a first axial section of the inner face of said mounting sleeve, a second axial section of the inner face of said mounting sleeve having reduced inner cross section with respect to the inner cross section of said first section, a substantially axial directed shoulder face being defined between said first axial section and said second axial section of said inner face abutting against said outward directed projection, so as to define one of the terminal positions of said mounting sleeve with respect to the respective member.

15. A spring device as claimed in claim 14, wherein said outward directed projection is provided by a circlip inserted in an annular groove of the outer face of the respective member.

16. A spring device as claimed in claim 15, wherein said circular groove is of such depth as to permit elastical restriction of the circlip which permits passing of said second axial section of said inner face of said mounting sleeve over said circlip when initially mounting the mounting sleeve on the respective member.

17. A spring device as claimed in claim 16, wherein a tapered face is provided at one end of said mounting sleeve adjacent said second axial section of said inner face, which tapered face exerts restriction forces on said circlip when said mounting sleeve is initially mounted on to the respective member.

18. A spring device as claimed in claim 1, wherein said fastening means provide a fastening member fixed with respect to the respective member, engagement means being provided on said fastening member for engaging the respective object, said engagement means permitting a lost motion between said fastening member and the respective object.

19. A spring device as claimed in claim 18, wherein said connection means provide an elongated slot in said fastening member, said elongated slot engaging the respective object.

20. A spring device as claimed in claim 1, wherein said lost motion means are provided with spring means biasing the respective object and the respective member toward one end of the limited lost motion.

21. A spring device as claimed in claim 20, wherein said spring means exert a smaller force than said biasing means.

22. A spring device as claimed in claim 1, wherein said lost motion means permit lost motion in the direction of said axis.

23. A spring device as claimed in claim 1, wherein said lost motion means are associated to the fastening means provided on said piston rod member.

24. A spring device as claimed in claim 1 in connection with a construction comprising an object movable on a path of movement, the movement of said object being resisted by an external force within a first section of said path and being substantially free of such external force in a second section of said path said spring device being connected to said object so as to assist movement of said movable object within said first section of said path against said external force said lost mo-

tion means permitting movement of said object within said second section of said path without force exertion by said spring device.

25. A spring device as claimed in claim 24, wherein said object is a movable roof element.

26. A spring device substantially as described with reference to the accompanying drawings.

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